Space Weather Technical Forecast

Issued on Friday, 20 October 2023 at 01:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Weak CME arrivals possible, with a Slight Chance of isolated G1/Minor Geomagnetic Storm intervals throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity as recorded at GOES16 and 18 has been Low over the past 24 hours, with only low level C-class flares, the largest of which was a C2.7 which peaked at 19/1400 UTC from AR3465.
There are currently three numbered regions on the visible disc and two unnumbered regions, all of which are relatively small and simple, and either stable or in decline.
A Coronal Mass Ejections (CMEs) is apparent in imagery, starting around 19/1800 UTC from the southeast quadrant from a plage region. This event will be analysed once more imagery becomes available, but is unlikely to be Earth directed.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE and DSCOVR at L1 started at slightly elevated levels around 430 km/s and then gradually declined to end the period at background levels around 320 km/s. The phi angle was accordingly positive (away from the Sun) throughout. The solar wind density remained at below average levels. The IMF was predominantly weak, although it did briefly reach moderate levels of 8 nT at 19/0126 UTC. Meanwhile the north-south component was mostly weakly negative, reaching -7 nT at 19/0554 UTC. Geomagnetic activity was Quiet to Unsettled (Kp 2-3).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at Background.
GOES16 high energy (greater than 2MeV) electron flux was at Normal Background for the vast majority of the time, only briefly touching Moderate levels with 114 pfu at 19/0020 UTC. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold. The observation at 20/0001UTC was 1.33e6 integrated pfu, after a gradually decreasing trend.

Four-Day Space Weather Forecast Summary

Solar Activity: Very Low to Low activity is expected. There is a Slight Chance of isolated M-class X-ray flares through the period, with any significant flares most likely from AR3465 on the visible disc but also from regions currently on the far side of the Earth which may rotate onto the Earth facing side within the forecast period.

Solar Wind / Geomagnetic Activity: The geomagnetic forecast is complex and carries high uncertainty, as evidenced by the MOSWOC Enlil ensemble spread. There are three potentially Earth directed CMEs. The C7.5 flare CME from the 16 October is the most likely CME to arrive, within the next 12 hours. Secondly, a CME associated with a filament eruption on 17 October may arrive in the 24 hours following. Thirdly and finally, a CME from an eruption on 18 October might follow this event by a further 24 hours. Therefore today, tomorrow and day 3 (20-22nd Oct) there is chance of geomagnetic activity becoming enhanced, but most likely today.

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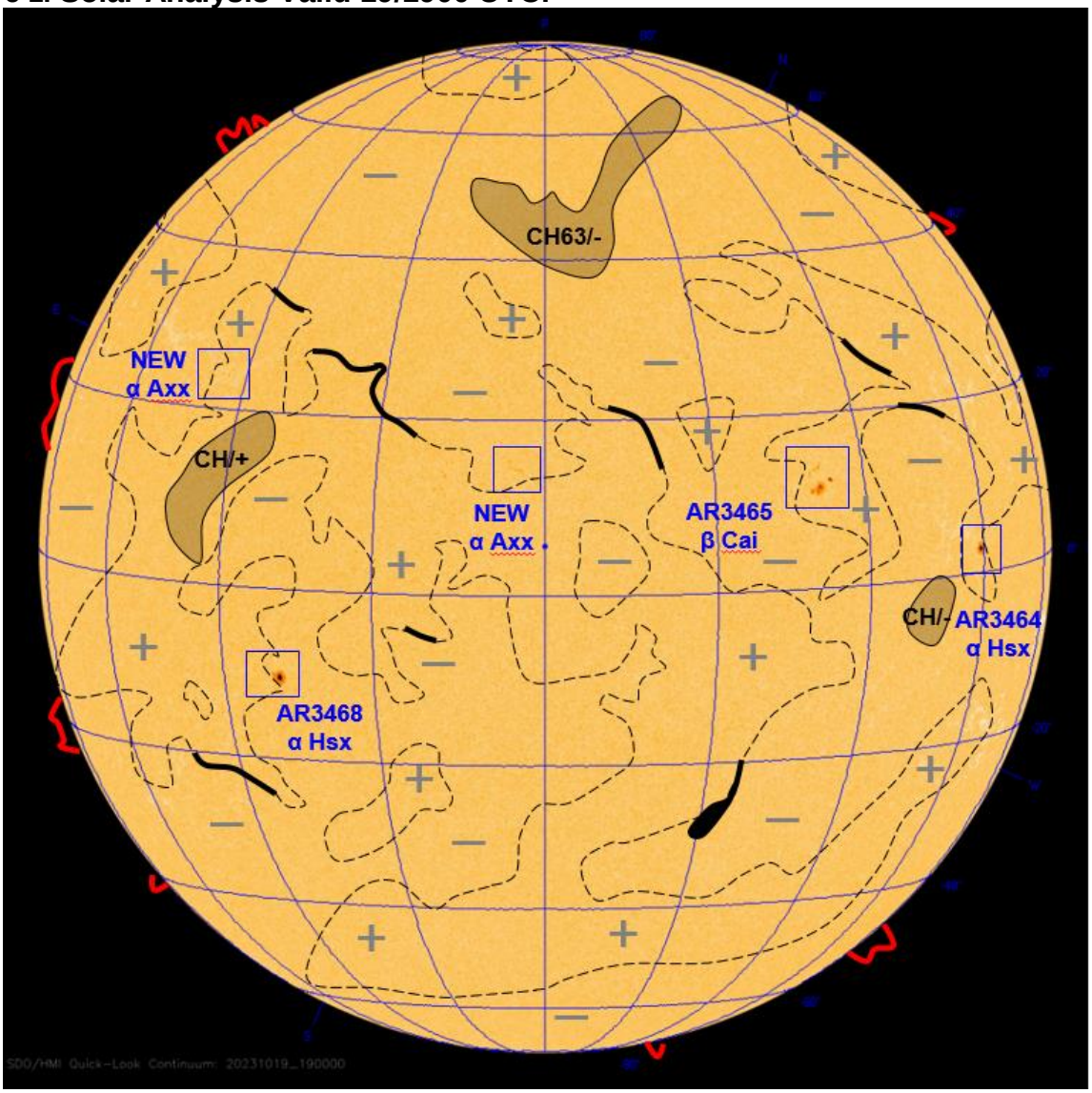
Met Office Space Weather Technical Forecast

The recent fast winds from CH60/+ have now abated. A potential weak enhancement from CH62/- may arrive over the next two days, but confidence is low as the coronal hole feature is now small and diminishing.

Geomagnetic activity is likely to be Quiet (Kp 1-2) for much of the time, but with spells of Unsettled to Active (Kp 3-4) activity and a Chance or Slight Chance of G1/Minor Storm (Kp 5) intervals if and when any CME's arrive.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to persist at Background levels. High energy electron flux (greater than 2MeV) is expected to be at Normal Background, perhaps rising to Moderate depending on the strength of any CME-sourced enhancement that occurs. The associated 24-hour electron fluence is expected to remain below Active (1e8 integrated pfu).

Figure 1. Solar Analysis Valid 19/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The geomagnetic forecast is complex and carries high uncertainty, but of overall the forecast is for relatively low activity. There is a significant overlap in inbound CME arrival times as evidenced by the MOSWOC Enlil ensemble spread. There are three possibly Earth directed CME's.

First is the CME which left the northeast disc on 16 October, associated with the C7.5 from AR3467. The bulk of the material is modelled to miss, passing behind Earth, but with the chance of a glance today (Friday 20th October), most likely within the next 12 hours.

Another CME was also observed from a filament eruption near Ex-AR3463 off the southwest disc early on 17 October. This is also expected to largely miss, passing ahead and south of Earth, but with the potential for a glancing impact either late today or early tomorrow (Friday 20th into Saturday 21st October).

The final CME was observed from the southeast around 18/0530UTC. This has been assessed as passing to the south and behind Earth late tomorrow or early day 3 (Saturday 21 into Sunday 22 October), also with a slight chance of glancing impacts.

The recent fast winds from CH60/+ have now abated. A potential weak enhancement from CH62/- may arrive over the next two days. However, confidence is low as this coronal hole feature is now small and diminishing and therefore much-reduced compared to the previous 27-day solar rotation, when very little enhancement was observed.

Geomagnetic activity is likely to be Quiet (Kp 1-2) for much of the time, but with spells of Unsettled to Active (Kp 3-4) activity and a Chance or Slight Chance of G1/Minor Storm (Kp 5) intervals if and when any CME's arrive.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	40	20	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

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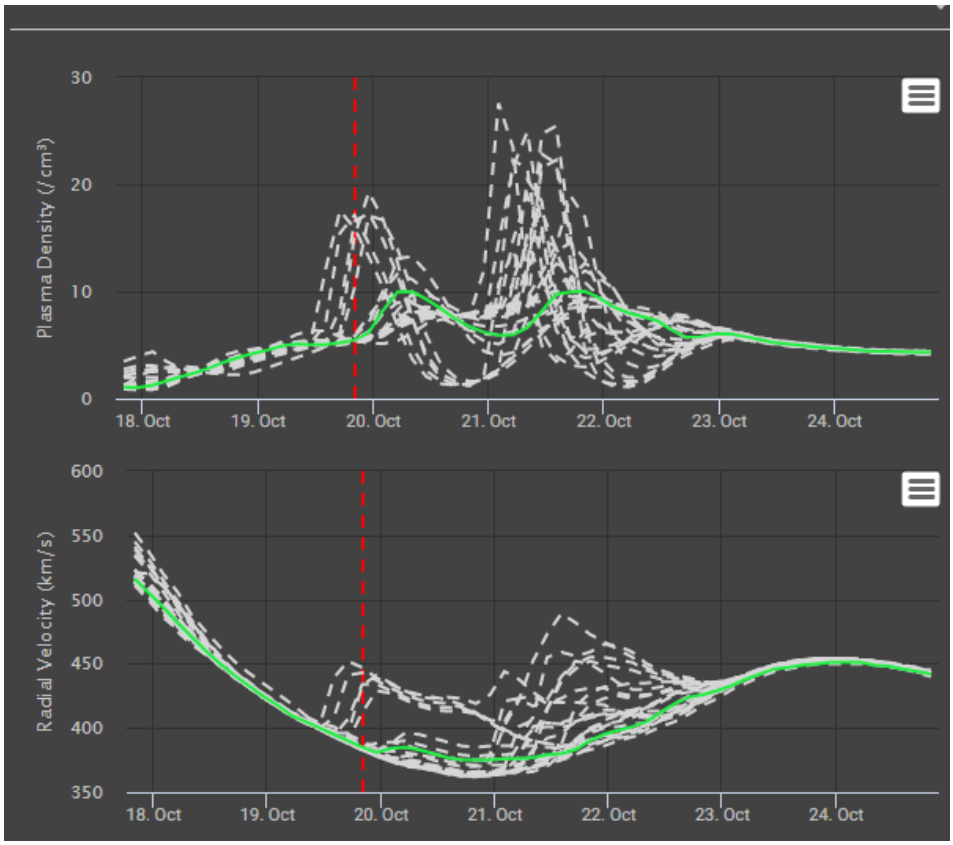
Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/1730	Partial	C7.5 AR3467	NE	680	20/0100 UTC	Low confidence. Glancing impact.
17/1430	Partial	Filament	SW	480	Late 20th or early 21st	Very low confidence. Likely miss.
18/1132	Partial	Filament	SE	610	Late 21st or 22nd	Very low confidence. Likely miss.

Figure 2: Met Office Enlil Ensemble forecast.



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Radio Blackouts - X-Ray Flares:

There are currently three numbered regions on the visible disc, and a few barely visible unnumbered regions. All regions are small, simple and either stable or were previously in decline. Activity is expected to remain Very Low to Low, with only isolated C-class flares likely in the absence of any significant regions currently on the visible disc. However, towards the end of the period new or returning regions may rotate on from the far side, which is indicated in the slight increase in flare probabilities.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is most likely to persist at Background levels, due to the lack of significant regions on the visible disc.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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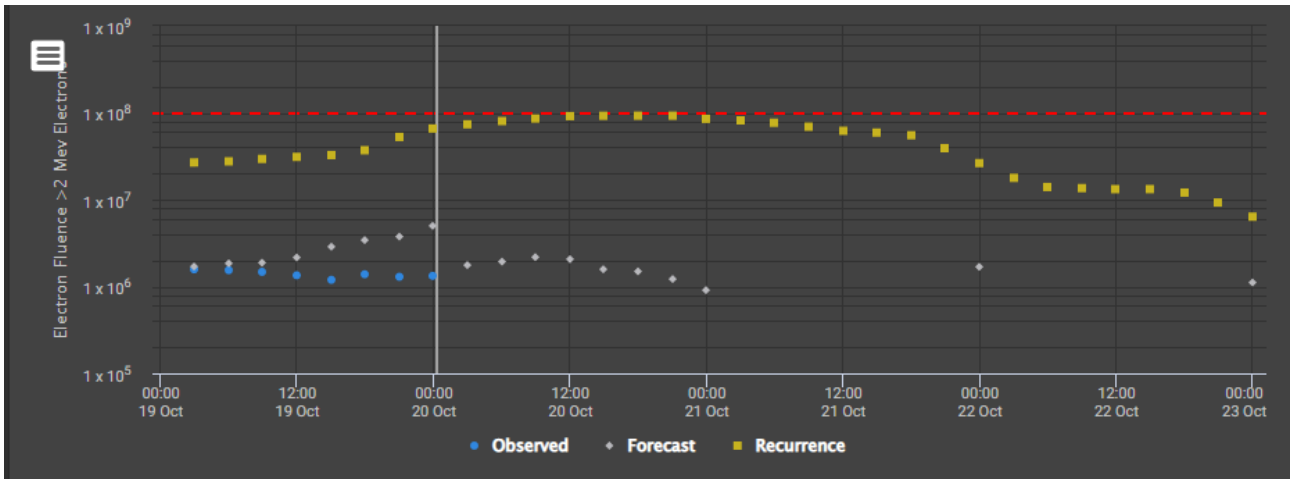
High Energy Electrons Event (≥ 2MeV):

Electron flux observed by GOES16 at GEO is currently at Normal Background levels. Solar wind enhancements are possible through the coming days, mainly associated with a number of potential CME arrivals throughout the period, or the onset of a weak HSS from the small coronal hole CH62/-. These are all low confidence however, and any enhancement is expected to be largely weak. These may increase electron populations in the Van Allen belts at times, which could bring periods of Moderate flux, most likely towards the end of the period.
The associated 24-hour fluence is expected to remain well below the Active threshold, as supported by MOSWOC REFM. However, the model will only provide good guidance in the absence of any CME or fast wind enhancements. Therefore, with the chance of a weak HSS and potential glancing blows from CME's, fluence levels may increase slightly towards the end of the forecast period, and this trend is not indicated by REFM.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	5	10
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: Met Office REFM model.



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